

# Integrated Energy Systems Program Peer Review

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**May 2, 2002**



## **Waukesha – Trane IES Project**

**Ted Bronson**

**Associate Director, Distributed Energy**

**Gas Technology Institute**

# Agenda

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- Introduction
- Project Goals
- Task Definition
- Project Status
- Potential Technical Hurdles
- Summary

# Introduction

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## ■ Project Team/Partnerships

- Department of Energy (DOE)
- Oak Ridge National Laboratory
- Gas Technology Institute (GTI)
- The Trane Company
- Ballard Engineering, Inc.
- Charles Equipment Co.
- University of Illinois at Chicago (UIC)

# Gas Technology Institute

John Riordan  
CEO

Stan Borys  
COO

Robert Stokes  
VP R&D

Exploration,  
Production & Gas  
Operations Center

Energy  
Utilization

Energy  
Systems

Distributed  
Energy

Environmental  
Sciences

- Gas Storage
- Gas Processing
- Advanced Production Methods
- Gas T&D
- Pipeline Safety
- Corrosion Detection and Prevention
- Automation

- Lower Emissions
  - Furnaces
  - Boilers
  - Appliances
  - Power Gen
- Gasification
  - Coal
  - Bio-Fuels

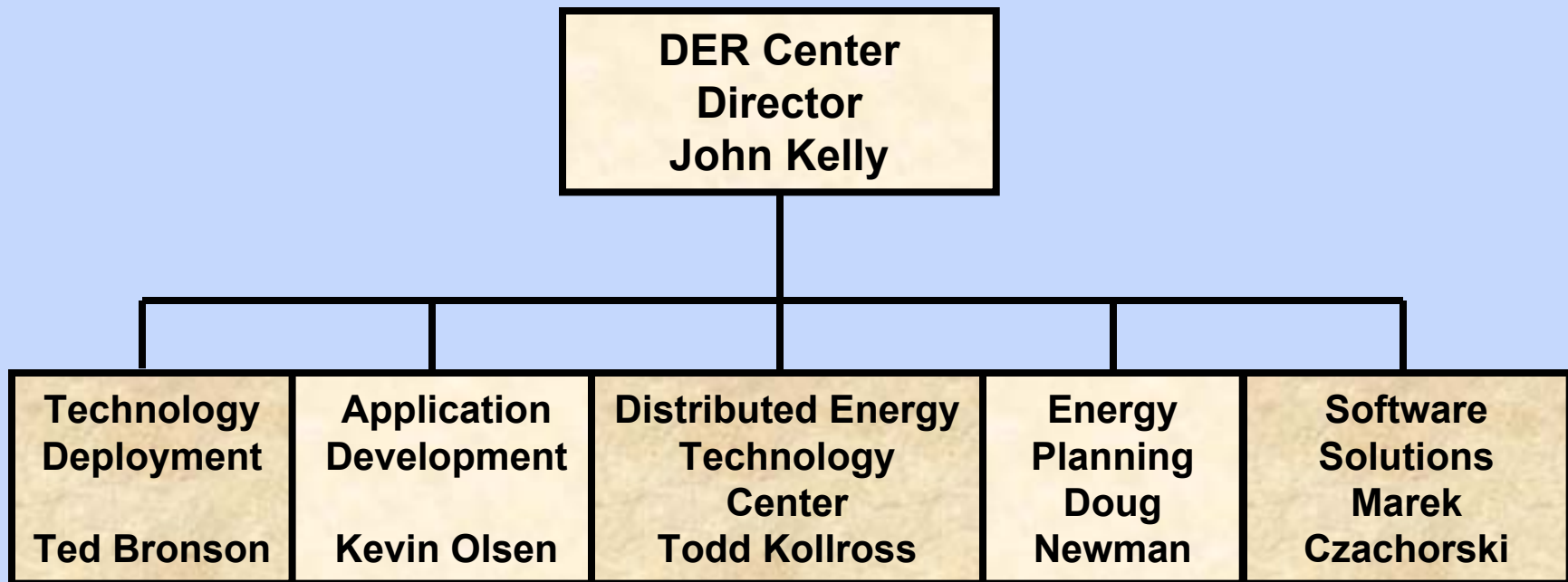
- Fuel Cells
  - PEM
  - SOFC
- Alternative Fuels
- Hydrogen Infrastructure

- DE Technology Development
  - Microturbines
  - Recips
  - Packaged Systems
- DE Deployment
  - Demos
  - Regional CHP Initiatives
  - Energy & Env. Planning

- Remediation
- Anaerobic Digestion
- Microbiology & Value Added products
- Clean Water

DE Center focused on accelerating the deployment of clean energy technologies

# GTI's Distributed Energy Resource Center



**Leverage GTI  
Capability**

**GTI R&D Division  
GTI Education Division  
GTI DG Programs:  
DG Mutual Fund; SMP**

# The Trane Company

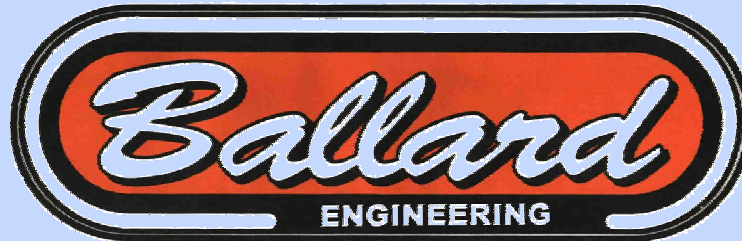
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- Leader in HVAC Systems for Commercial and Industrial Buildings
- Global Company - Trane has Offices, Service Operations, Joint Ventures and Manufacturing Facilities Around the World.
- In-House Absorption Technology Development Staff

# Ballard Engineering, Inc.

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- Established in 1983, as a Division of Ballard Companies
- Turnkey Provider of CHP Plants for:
  - Hospitals
  - Institutions
  - Industrial Plants
- Experienced with Reciprocating Engine Generating Set and Absorption Chiller Integration
- Experienced in SCADA and Controls Integration

# Ballard Engineering, Inc.

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**CONTROL  
ROOMS**



**ENGINE  
ROOMS**



**HEAT REJECTION  
EQUIPMENT**



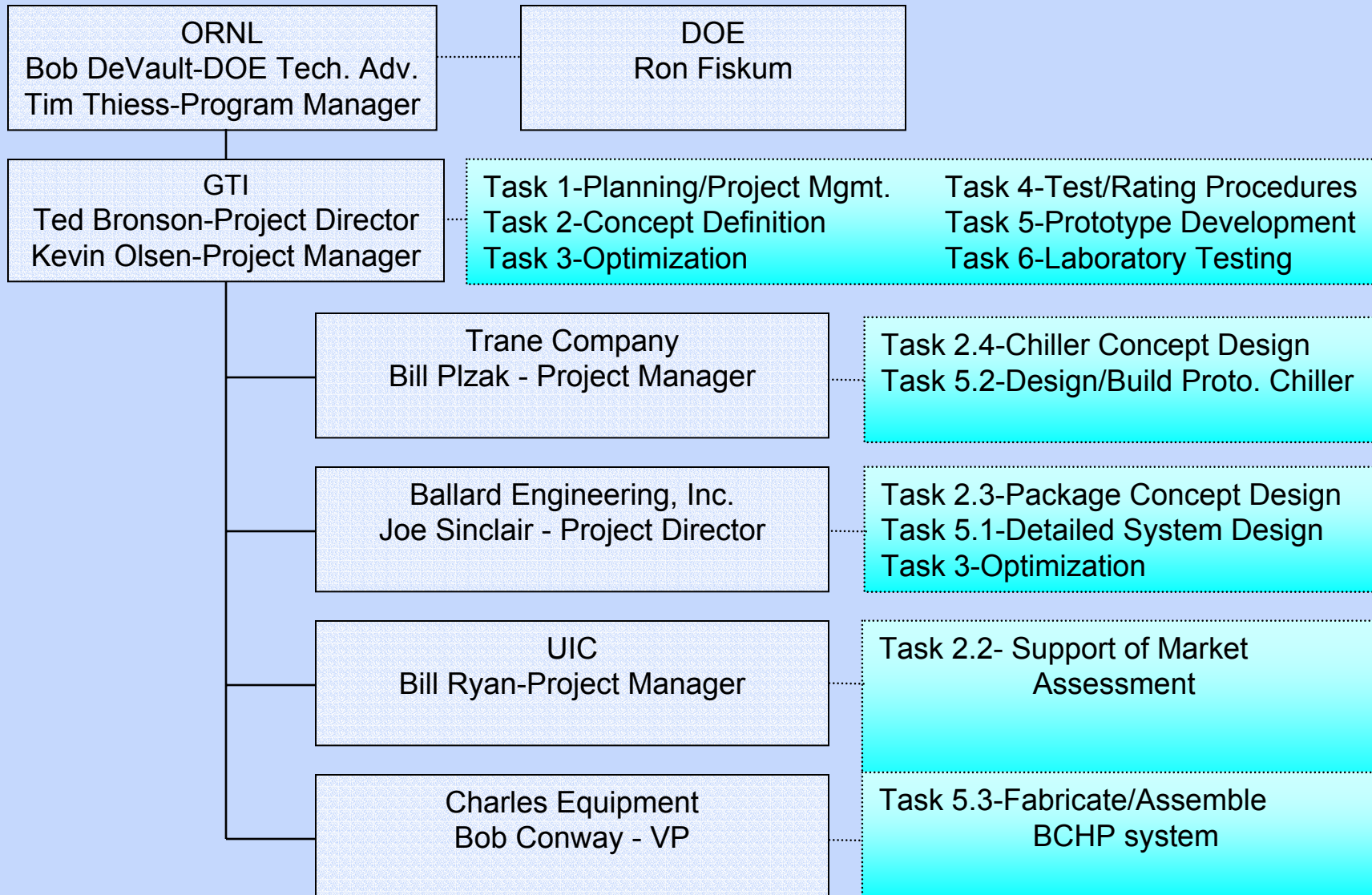
# University of Illinois at Chicago (UIC)

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- Mid-West CHP Application Center
- Industrial Application Center
- Marketing Studies
- Site Assessments
- Outreach Activities

# Project Organization



# Project Goals

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- Develop and demonstrate through Laboratory Testing a Modularized “Plug and Play” System supplying:
  - Electricity
  - Hot Water
  - Chilled Water
- Optimize System to:
  - Reduce Capital Cost
  - Improve Energy Efficiency
  - Reduce Maintenance Costs
  - Increase Reliability

# Project Goals

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- Provide Engineering “Template” for which commercialization of a broader product range can be launched in Phase 2 of the Project.
- Leverage Manufacturer Distribution channels
  - Fabrication
  - Commercialization / Sales
  - O&M Support

# Task Definition

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## Phase 1 Task Definition

Task 1 - Project Startup, Planning and Closeout

Task 2 - System Concept Definition

Task 3 - Analytical Optimization

Task 4 - Testing and Rating Procedures/Standards

Task 5 - Prototype Development and Fabrication

Task 6 - Laboratory Testing

## Phase 2 – Commercialization/Demonstration

# System Conceptual Design



# Project Status

## System Development

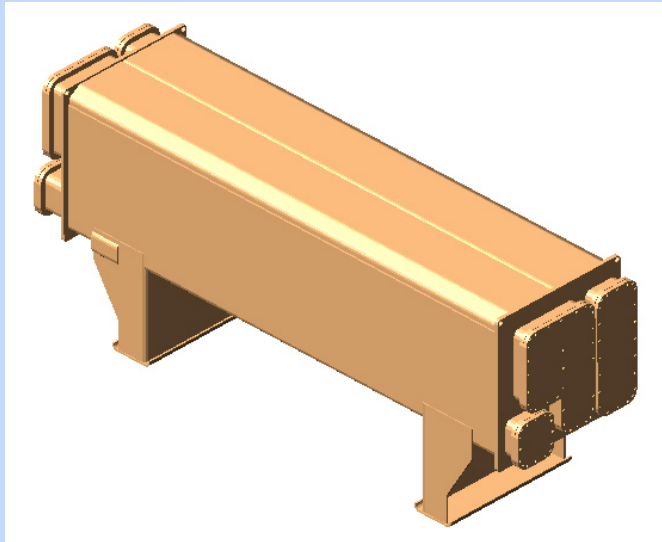
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### Summary

- Work Completed
  - Conceptual System Development
  - Preliminary Equipment Specification
- Work Planned
  - Complete Detailed Design
  - Prepare Detailed Equipment Specification
  - Finalize Controls Design/Integration
  - Support Fabrication and Testing

# Project Status

## Absorption Chiller Development



### New Technologies

- Cycle *optimized* for low temp. input
- Falling-film generator
- Counter-flow generator and absorber
- Low-cost, high-effectiveness HX

### Objectives

- Rapid access to emerging BCHP system market
- State of the art design using proven Horizon<sup>R</sup> technology
- Global product platform

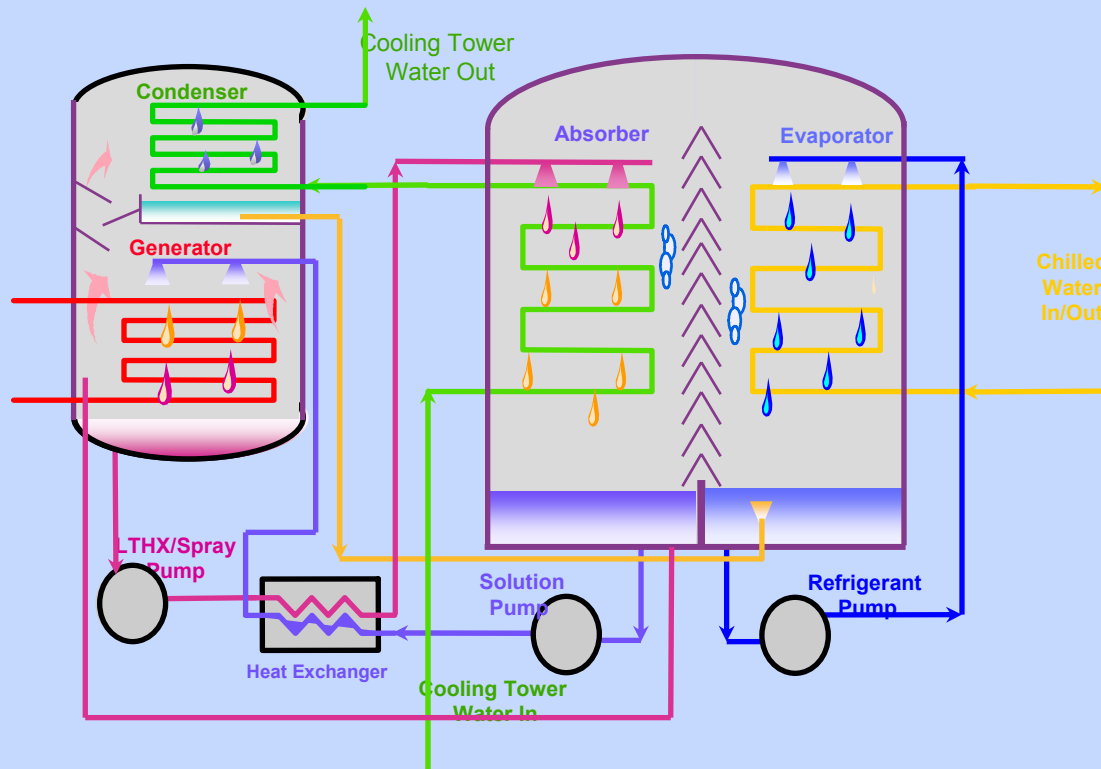
### Benefits

- Provides access to both emerging and established markets
- Low cost product
- Designed to interface with pre-engineered BCHP package systems
- Fast track project



# Project Status

## Absorption Chiller Development



### Design features

Counterflow falling-film generator for optimal utilization of low temperature heat sources.

Solution through heat exchanger pumped on both sides for compact design.

Component platform same as Horizon II for ease of manufacturing and lowest product cost.

# Project Status

## Absorption Chiller Development

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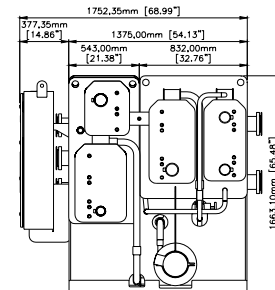
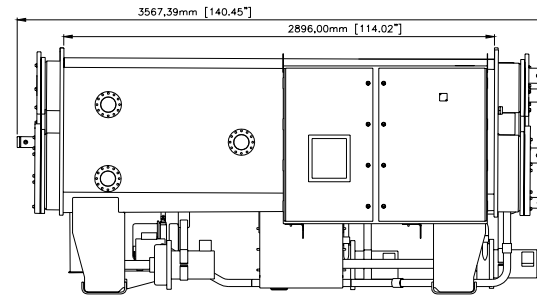
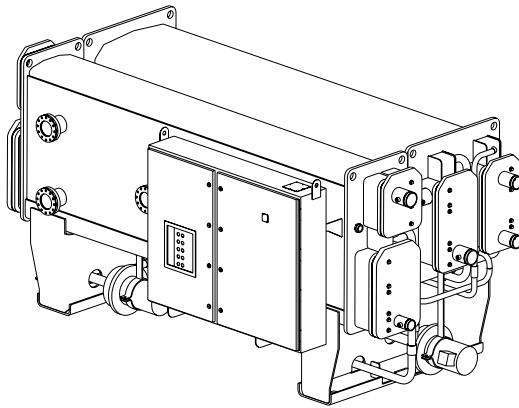
### Summary

- Work Completed
  - Concept Development
  - Design Optimization
  - Production Drawing Package for 90 ton Chiller
- Work Planned
  - Build 90 ton Prototype Chiller
  - Test 90 ton Chiller At Trane's Lab
  - Support System Integration and Testing

# Project Status

## Absorption Chiller Development

### BCHP-90



# Project Status

## Market Potential Assessment

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- **Development of Market Building Demographics**
  - **Matrix of 5 commercial building types at 9 geographical location (45 building load profiles)**
    - hospital, large hotel, large educational facility, large retail, large office
    - Chicago, New York, Miami, Tampa, Dallas, Houston, San Diego, Boston, Newark. Target building sector types identified based mainly on the building specific energy density.

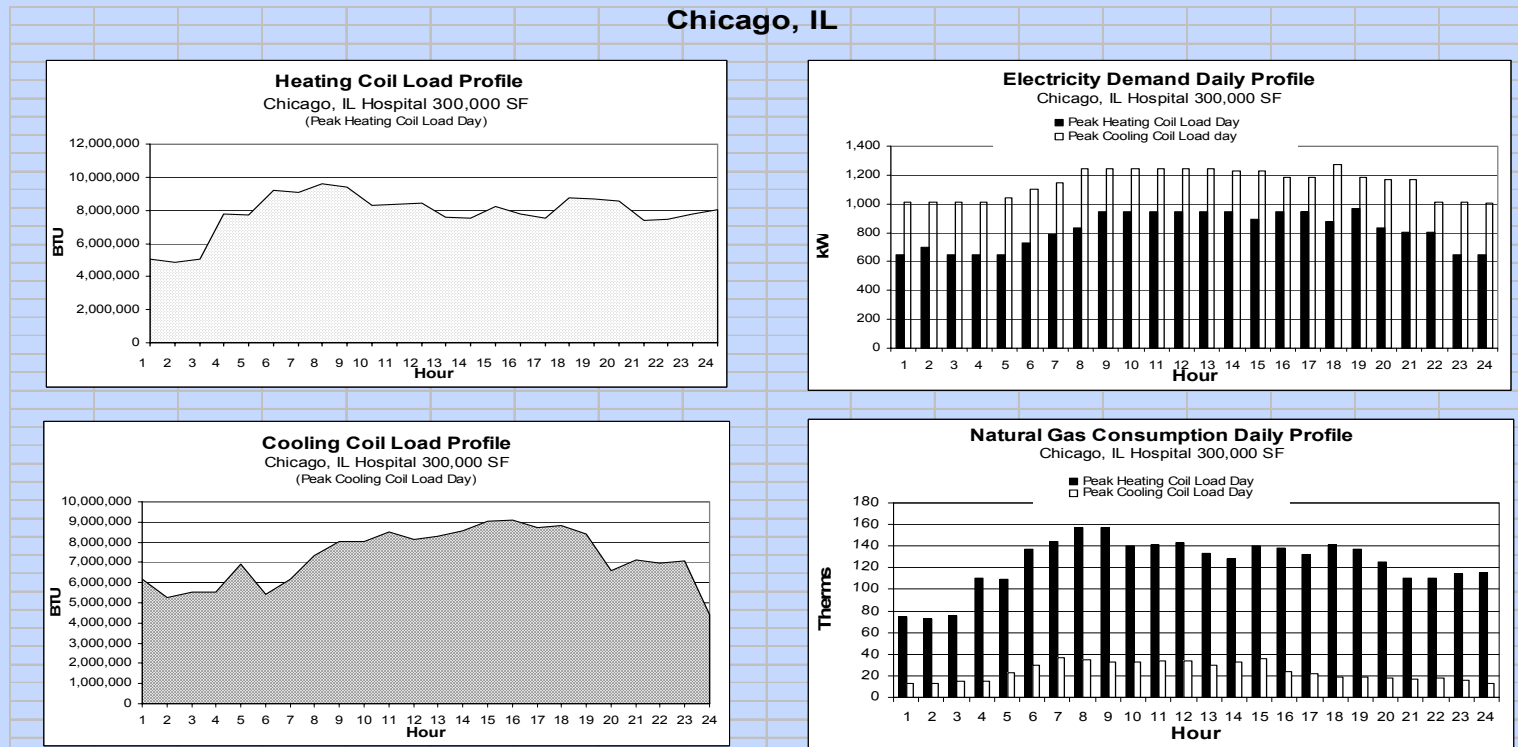
*The nine cities were selected for modeling based on combination of high energy density of the target building sectors and high cost of electric energy in that city.*

# Project Status

## Market Potential Assessment

### ■ Development of Building Load Profiles

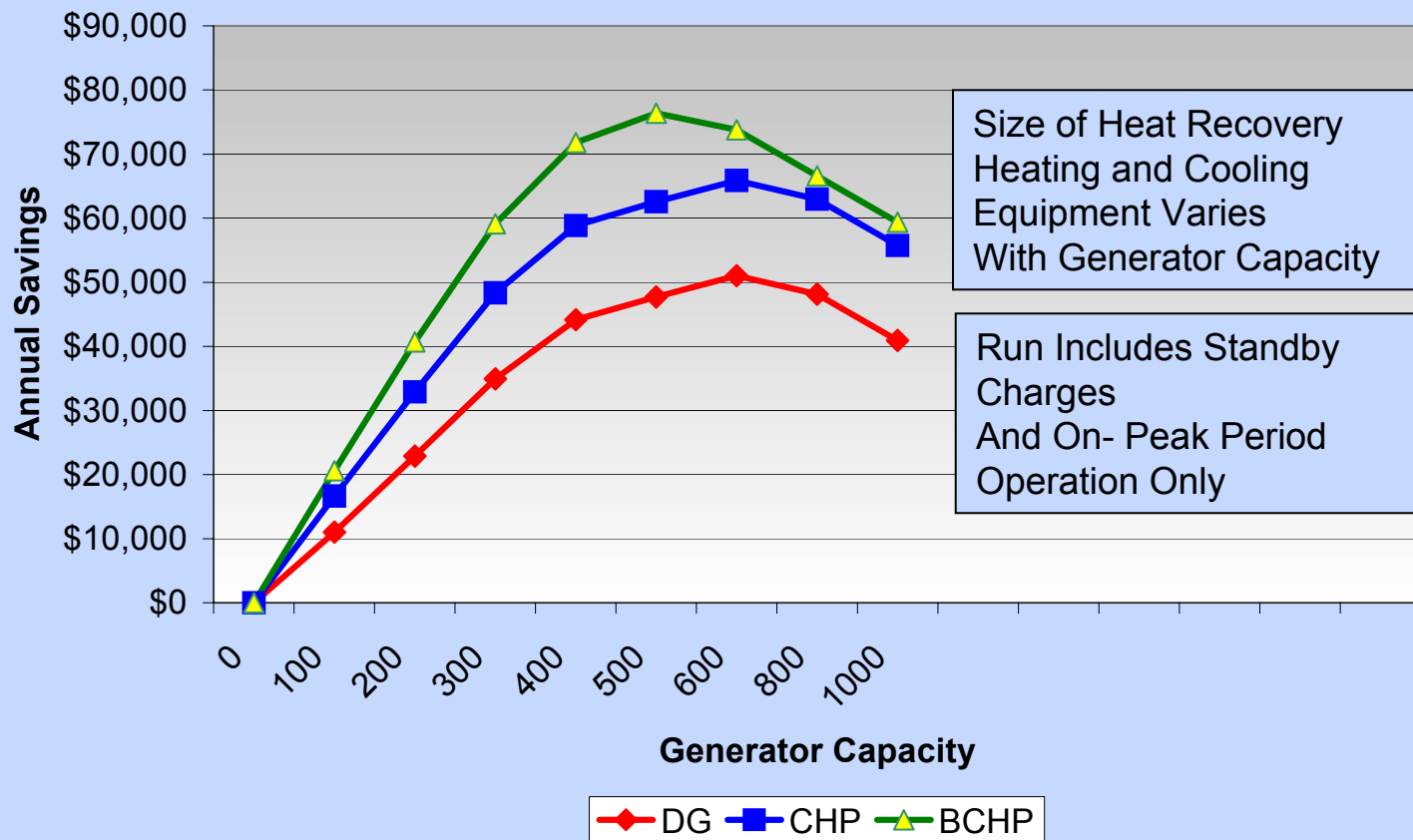
—45 / 8760 building load profiles were developed using DOE2 version 1.E



# Project Status

## Market Potential Assessment

### BCHP Model Example Output Operating Cost vs. System Size High School Load



# Project Status

## Market Potential Assessment

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### Summary

- Matrix of Applications/Locations Developed Based on Domestic Building Populations/Energy Consumption Intensity Data Defined
- Building Populations and Economics Form Basis of the Market Study
- 45 Target Building/Location Loads Profiles Developed
- Energy Rates for 9 Target Locations Collected (90%)
- Test Runs of The Simulation Model Have Been Performed
- Model Needs Better/Specific Equipment Performance Information (test data).

# **Project Status**

## **Remaining Tasks for 2002**

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Task 4 – Testing and Rating Procedures/Standards is being performed with a nationally recognized standards organization covering testing and rating of IES systems. The Review Committee is currently being formed.

Task 5 – Detailed Design underway. Expected completion this Fiscal Year. Ordering of equipment and fabrication expected beginning of FY2003.

Task 6 – Laboratory Testing



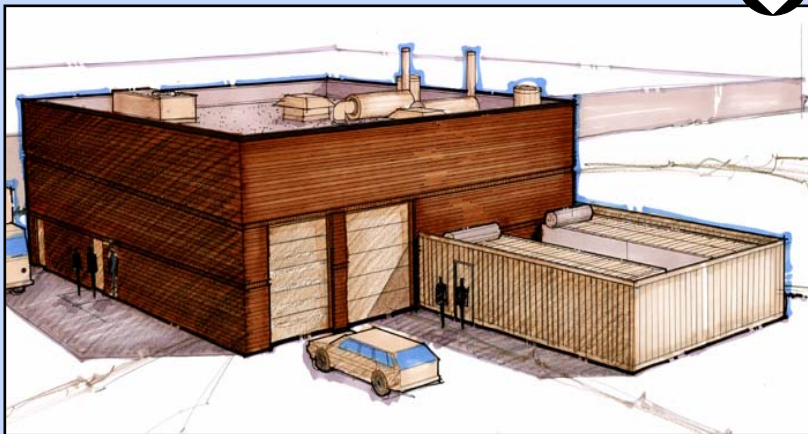
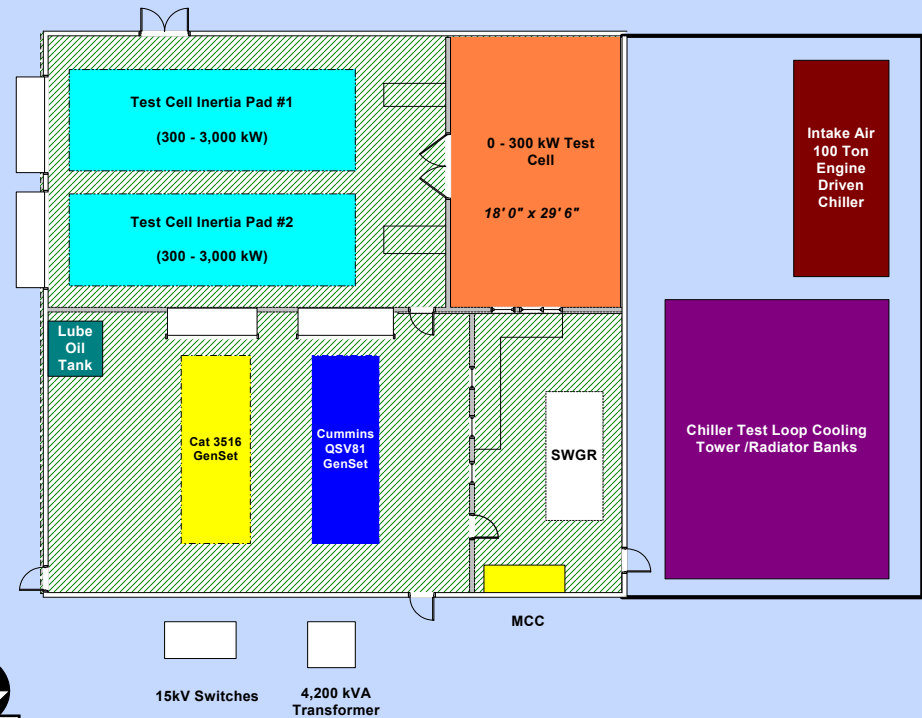
# GTI's Distributed Energy Technology Center

## Purpose:

- Technology Development
- Risk Reduction
- Certification

## DE Equipment (10 to 3000 kws)

- Reciprocating engines
- Turbines / Microturbines
- Fuel Cells
- Packaged units with absorption chillers / desiccants
- Hybrid Gas / Renewable systems



## Operation of Cell

- Uses 0 – 300 kW Test Cell for treatment of intake-air conditions
- Modulating dampers for exhaust pressure
- Cooling towers and radiator banks for testing chiller

# GTI's Distributed Energy Technology Center

- 0- to 300-kW Test Cell Environmental Chamber
- Grid-connect or “island” mode
  - Monitor power quality
  - Resistive and reactive load banks
  - Power factor testing
- Heat Recovery Equipment Test Loop
  - Cooling tower (190 - 2,000 kW)
  - Test both heating, cooling equipment (i.e., absorption chillers)
  - Ambient temperature range for cooling: 60 to 105 degrees F



BCHP System Development

# Technical Barriers

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- **Proposed Emissions Regulations**
- **Integration of System Controls with End User Building Controls**
- **Prototype Equipment Cost**

# Summary

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- **Calculated performance meets the 70% System Efficiency.**
- **Project is on Budget**
- **No Major Hurdles Identified or Anticipated**